

How to use this textbook.

In order for you to use this textbook effectively, please note there are some features in this textbook which I want you to note.

① Why do I have to study this chapter?

This paragraph explains the purpose of each chapter for you to study. I highly recommend you to read briefly especially when you are not familiar with particular topic you are studying.

② Expected Hurdles Ahead in this Chapter

This paragraph gives you some warnings on the topics which may cause you some difficulties.

③ PREVIEW OF KEY-EQUATIONS

This section lists up the equations showing up in each chapter. I am showing the equations before the chapter begin in order to get you familiar with the core equations which you are studying

1 • **Why do I have to study this chapter?**
Any work requires energy. So as the chemical reactions. You need to know how much energy is required? Let's learn how to calculate the amount of energy lost or gain, or work? The energy is another important thermochemical concept, which especially describes heat specifically from randomness?

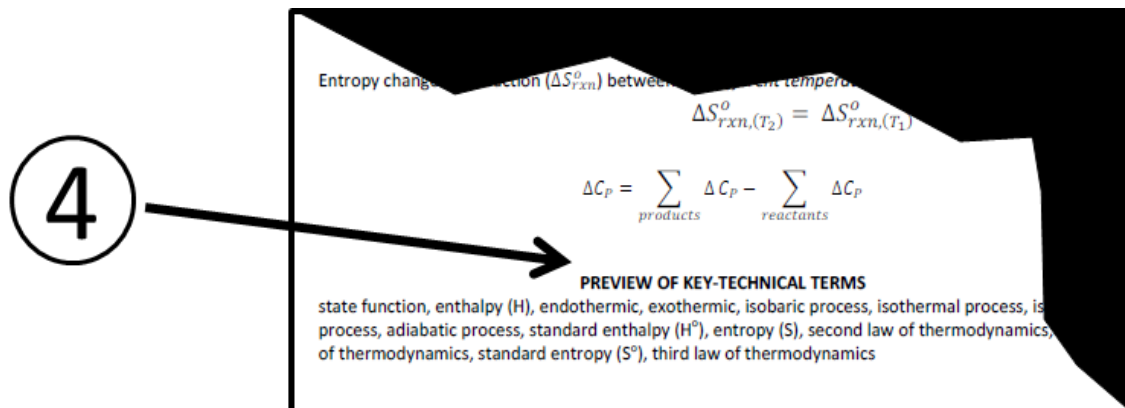
2 • **Expected Hurdles Ahead in this Chapter**
1. Understanding the sign of work and heat (See Section 1-1)
2. Watch for the temperature dependence of the heat and entropy. (See Section 1-2)

3 **PREVIEW OF KEY-EQUATIONS**

Internal Energy Change	$\Delta E = q + w$
PV work	$w = -P\Delta V$
Enthalpy Change	$\Delta H = \Delta E + P\Delta V$
Enthalpy Change (gas)	$\Delta H = n\bar{C}_p\Delta T$
Internal Energy Change (gas)	$\Delta E = n\bar{C}_v\Delta T$
Internal Energy/Enthalpy Change (liquid & solid)	$\Delta H \cong \Delta E = n\bar{C}\Delta T$
Enthalpy Change (constant Temperature)	

④PREVIEW OF KEY-TECHNICAL TERMS

New and very important terms used in each chapter are listed for you to preview.



⑤EXERCISE

Selected exercise problem is listed and explained. It shows the example of how you want to approach it.

① This sign in **EXERCISE** indicates the tricky part of the problem. It give some help for you to solve the problem correctly.

⑥Most Common Mistake



MCM

Most Common Mistake

It lists the common mistake which students may commit when they solve the problems. Please review those items before you take the exam.

(Eqn. 1-5) with $P_{ex} \sim 1 \text{ atm}$. The important unit conversion for calculating the amount of work from $[\text{atm} \cdot \text{L}]$ is $1 [\text{atm} \cdot \text{L}] = 101.3 [\text{J}]$.

5 → **EXERCISE 1-1.**
Each inhalation to the lungs of an adult involves pushing out about 0.5 L of gas against 1 [atm] of pressure. This occurs about 15,000 times in a 24 h day. Estimate the amount of work in breathing done by each person in a course of 24 [h].

6 → **ANSWER**

$$w = - \int_{V_1}^{V_2} P_{ex} dV = -P_{ex} \Delta V = -P_{ex} (V_2 - V_1)$$

1 [L · atm] = 101.3 [J]
 $P = 1 [\text{atm}]$, $\Delta V = 0.5 [\text{L}]$
 $P \Delta V = (1 [\text{atm}]) (0.5 [\text{L}]) (101.3 [\text{J}] / [\text{L} \cdot \text{atm}]) \sim 50 [\text{J}/\text{breath}]$
 During 24 [h] - 15,000 times
 $50 [\text{J}/\text{breath}] \times 15,000 = 750 [\text{kJ}]$

1 [L · atm] = 101.3 [J]
 It has a negative sign in front of $P \Delta V$!!

Most Common Mistake (1) -Why I cannot calculate the work correctly?
 Most common mistake people make in the calculation of EXERCISE 1-1 can be the unit conversion between [L · atm] and [J].

⑦ Derivation of Formulas

Σ The formula with this mark have derivation at the later section of the chapter. This textbook is intended to give you the short cut of what to know or where to study. In order to focus on the problem solving, the equations or formulas needed for solving problems are given without derivations. Therefore important derivations are given in the later section.

How did you get these equations?-The derivation of selected equations.

This section provides explanations on important formulas need significant steps for derivations.

The formula with Σ sign is treated in this section and the derivations are given.

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listed in the above. The following calculations are for the case of gas. Here, we use heat capacity as \bar{C} , and a number of moles, n .

i) Isobaric process

$$q_P = n\bar{C}_P(T_2 - T_1) \quad (\text{Eqn. 1-11}) \quad \Sigma$$

$$w_P = -P(V_2 - V_1) = -nR(T_2 - T_1) \quad (\text{Eqn. 1-12}) \quad \Sigma$$

The work at constant pressure, w , is graphically demonstrated below.

Chapter 1



How did you get these equations?
-The derivation of selected equations.

$$(\text{Eqn. 1-11}) \quad q_P = n\bar{C}_P(T_2 - T_1)$$

For any a substance with heat capacity, C_P , at constant pressure, the heat q_P is given by

$$q_P = \int_{T_1}^{T_2} C_P dT = C_P(T_2 - T_1)$$

Since heat capacity is given by

⑧ Chapter Summary and Summary Check.

This page shows the table of the summary which can be used for exam review. It shows the item on the left and explanation on the right. This page is meant for you to use quick review for the exam. The summary check page is for book keeping your summary process. You may want to hold the page to hide the previous page to hide the explanation, and practice for yourself to explain. If you feel comfortable, please check on box. □

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CHAPTER 1 SUMMARY [PART 1]
(Use back page to cover the contents.)

1	first law of the thermodynamics	The energy of universe is conserved.
2	internal energy change (ΔE)	$\Delta E = q + w$ (Eqn. 1-1) ΔE ; internal energy change of a system, q; heat, w; work
3	PV work (w)	$w = -P\Delta V$ (Eqn. 1-2) w; work, P; pressure, ΔV ; volume change
4	heat (q)	$q = C\Delta T$ (Eqn. 1-3) C; heat capacity
5	system and the surroundings sign of q and w	system is a reaction center and the surroundings is the rest of everything else. If heat (q) or work (w) is accepted to the system $q > 0$ and $w > 0$. If heat or work is lost from the system,

CHAPTER 1 SUMMARY [PART 1]
(Use back page to cover the contents.)

1	first law of the thermodynamics
2	internal energy change (ΔE)
3	PV work (w)
4	heat (q)
5	system and the surroundings sign of q and w

CHAPTER 1 SUMMARY CHECK [PART 1]
(Use this page to cover and check the contents.)
Use ☐ as your check box. Write your comments.

1	first law of the thermodynamics
2	internal energy change (ΔE)
3	PV work (w)
4	heat (q)
5	system and the surroundings sign of q and w

⑨ “Your Teacher May Test You On...”

This section lists up the topics which may be asked in the exam. The recommended EXERCISE and problems are also listed for each item. After you are done with reviewing summary, you may want to go through this section and practice more on your weak spots.

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Chapter 1 - YOUR TEACHER MAY TEST YOU ON:

No.	What may be asked?	What you should know or do?
1	How do you calculate the PV work in J unit?	$w = -P\Delta V$ (Eqn. 1-2) $w = -\int_{V_1}^{V_2} P_{\text{ext}} dV$ (Eqn. 1-3) $w = -P_{\text{ext}}(V_2 - V_1)$ (Eqn. 1-4) $1 \text{ [atm}\cdot\text{L]} = 101.3 \text{ [J]}$ EXERCISE 1-1 Problems 1-1
2	How do you calculate the heat, q?	$q = \int C dT$ (Eqn. 1-5) EXERCISE 1-2

⑩ Unit Check

Many troubles may take place in unit conversion or using wrong unit. This section sums up all terms used in each chapter sometimes with conversion factor or constant values.

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UNIT CHECK CHAPTER 1

Important Parameters of This Chapter	Popularly Used Unit	Important Unit Conversion
Internal Energy, E	J/mol kJ/mol	[J] = [kg m ² s ⁻²]
Internal Energy Change, ΔE	J/mol kJ/mol	
Heat, q	J, cal	1 [cal] = 4.184 [J]
Work, w	J	
Pressure	atm	1 [atm] = 101.325 [Pa] = 760 [torr]
PV work, PΔV	atm·L, J	1[atm·L] = 101.3 [J]

⑪ Summary of Tricky Traps

This section summarizes briefly on the tricky parts of each section. Use this section before you take exam.

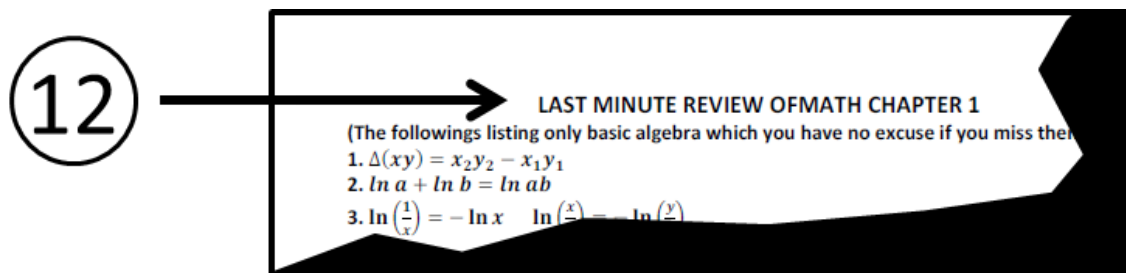
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SUMMARY OF TRICKY TRAPS OF CHAPTER 1

<input type="checkbox"/>	1	$\bar{C}_p = \bar{C}_V + R$ or $C_p = C_V + nR$
<input type="checkbox"/>	2	Sign of q, w, ΔE, and ΔH, are system centered definition.
<input type="checkbox"/>	3	Use ΔC _p for temperature dependence of ΔH _{rxn} ⁰ and ΔC _p is the difference between products and reactants.
<input type="checkbox"/>		In the following...

⑫ Last Minute Review of Math

This section lists up really basic math which you probably do not have to worry about at all. However, I listed them up on purpose, since people seem to get panic before the exam and tend to forget about very simple things. If you are getting nervous about exam, then take a look at this section at last minute and feel confident and comfortable. Then, take your exam.



Also the following features are added to each chapter:

Nobel Prize and Your Knowledge From Chapter 1

I want you to connect your knowledge of each chapter with scientific achievement recognized by Nobel prize. The contents are focused more to Physical and Biochemical applications.

The focused physical chemistry experimental approach associated with each chapter:

This section adds up advanced experimental technique to what you learned in each chapter. This section can be skipped if you have too much to worry about your study. However, please take a look at one or two sections, you may find them very interesting.

End of Chapter Problems

The related and similar problems with EXERCISE or additional drills on calculations are given. The section “**Your Teacher May Test You On**” suggest you which question you should do for your review. The detail answers for the problem are available separately.

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